

A REVISION OF THE SOUTHWESTERN SPECIES OF *AMSONIA* (APOCYNACEAE)¹

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ABSTRACT

Taxonomic studies based on herbarium and field plot observations were conducted on all species of *Amsonia* (Apocynaceae) native to the southwestern United States and northwestern Mexico. Within subgenus *Sphinctosiphon*, data obtained in this study from recent collections support the retention of *A. jonesii*, *A. kearneyana*, *A. palmeri*, *A. peeblesii*, and *A. tharpaii*. *Amsonia hirtella* and its varieties are reduced to synonymy with *A. palmeri*. In subgenus *Longiflora*, which is here elevated from its previous status as a section of subgenus *Sphinctosiphon*, *A. grandiflora* and *A. longiflora* are retained, and *A. salpignanthes* is treated as a variety of *A. longiflora*. In subgenus *Articularia*, one species with two varieties is recognized: *Amsonia tomentosa* var. *tomentosa*, including *A. brevifolia*; and *A. tomentosa* var. *stenophylla*, including *A. arenaria* and *A. eastwoodiana*. A key to the species and taxonomic synopsis are included.

Amsonia was described by Thomas Walter in 1788 and was first monographed and later revised by Woodson (1928, 1938). The taxonomic history of the genus was thoroughly reviewed by Woodson (1928) and will not be repeated here. The two studies by Woodson differed substantially in their treatments of the southwestern species, which he later (1948, p. 238) characterized as being "ambiguous species." Many of these southwestern species were known from only a few specimens. However, during the past 40 years numerous additional collections have been made of all species from the Southwest; therefore, it now seems appropriate to reexamine this particular complex group.

Amsonia species are herbaceous perennials from a woody, long-lived root. The leaves are simple, alternate to subverticillate, the middle and lower ones typically broadest, those above increasingly narrow distally. The flowers are white to light blue or pink, gamopetalous, with five calyx lobes, corolla lobes, and stamens. The distinct, unappendaged anthers are included within the tube of the salverform corolla. The pistil is composed of two distinct ovaries joined by a common style. The fruit is a pair of multiseeded follicles. The seeds are corky and lack an aril or coma. The distinct, unappendaged anthers place *Amsonia* in the tribe Plumeroideae of the Apocynaceae. The most closely related genus is *Haplophyton* A.DC., which differs principally from *Amsonia* in having comose seeds.

As treated here, the southwestern species constitute three distinct subgenera. *Amsonia* subgenus *Articularia* Woodson has articulate-moniliform follicles while those of subgenera *Sphinctosiphon* (K. Schumann) Woodson and *Longiflora* (Woodson) McLaughlin are continuous (Fig. 1). The corollas in subgenus *Sphinc-*

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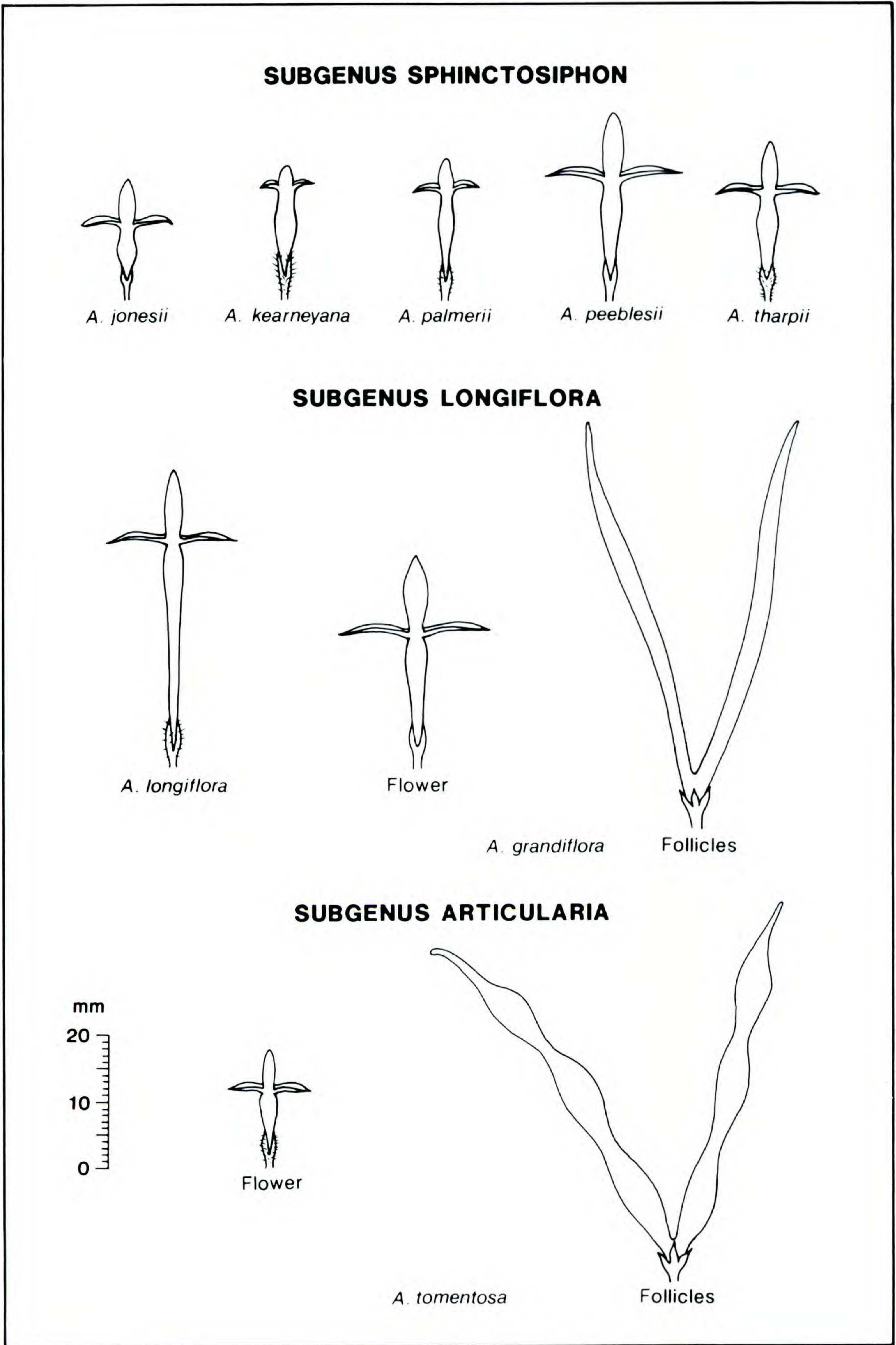


FIGURE 1. Corolla and follicle shape in southwestern *Amsonia* spp. Follicle morphology in subgenus *Sphinctosiphon* spp. is similar to that illustrated for *A. grandiflora* in subgenus *Longiflora*.

tosiphon have relatively short tubes that are only moderately constricted at the apex while those of subgenus *Longiflora* have longer, slender tubes that are markedly constricted at the apex (Fig. 1). The corolla tubes in subgenus *Articularia* are short with the apex markedly constricted.

The remainder of the species of *Amsonia* are all placed in subgenus *Amsonia*, which consists of eight species native to the southeastern United States and one species from Japan. I have not collected or worked with this last subgenus. The species of subgenus *Amsonia* are known from many collections and appear to be much better defined than the southwestern species, as shown by the similarity in the two treatments of the former by Woodson (1928, 1938).

METHODS

Collections were examined of all southwestern *Amsonia* species from ARIZ, ASU, MNA, MO, and TEX. Additional material of selected taxa from RSA, CAS, and NY were examined. Measurements of characters traditionally used to define and separate species were made on 300 specimens, over two-thirds of which have been collected since the last revision (Woodson, 1938). Characters measured include width of broadest stem leaves, corolla tube and lobe length, and seed length and width. Plants of four taxa of subgenus *Articularia* were grown in the greenhouse and in a field plot for additional observations and measurements (Table 3).

SUBGENUS *SPHINCTOSIPHON* (K. SCHUMANN) WOODSON

Twelve taxa have been described in this section, seven of which are currently recognized in either the Arizona (Kearney & Peebles, 1960) or Texas (Correll & Johnston, 1970) floras (Table 1). Species and varieties have been distinguished principally on the basis of pubescence, length of the corolla tube and lobes, and leaf shape (Woodson, 1928, 1938; Kearney & Peebles, 1960; Correll & Johnston, 1970). *Amsonia jonesii* Woodson, *A. peeblesii* Woodson, and *A. tharpii* Woodson are fairly distinct species, but treatments of *A. hirtella* Standl., *A. hirtella* var. *pogonosepala* (Woodson) Wiggins, *A. kearneyana* Woodson, and *A. palmeri* Gray vary considerably. Woodson (1928) accepted all four, along with *A. standleyi* Woodson, as distinct species; but he later revised the group recognizing only *A. palmeri* and *A. hirtella* (Woodson, 1938).

Gray (1877) described the first species in subgenus *Sphinctosiphon*, *A. palmeri*, from specimens grown from seed collected by Palmer in Arizona, exact location unknown. These plants were glabrous with narrow leaves and short corolla lobes. Plants meeting Gray's description occur only in Yavapai County, Arizona. Plants described as *A. kearneyana* (Woodson, 1928) have similar flowers, but the plants are pubescent and have considerably broader leaves. Woodson (1938) combined the two taxa and expanded the description of *A. palmeri* to include the variation in both forms. Kearney & Peebles (1960) followed Woodson (1928) in narrowly defining *A. palmeri* while Correll & Johnston (1970) followed the broader interpretation in Woodson (1938), with the result that most specimens from west Texas referable to *A. palmeri* using the Texas manual would be identified as *A. hirtella* using Arizona Flora.

TABLE 1. Range of variation of diagnostic characters of traditionally accepted taxa of *Amsonia* from the Southwest. 1. Based on Woodson (1928); 2. Based on Woodson (1938).

Taxon	Pubescence		Leaf Width (mm)	Corolla		Seeds	
	Foliage	Calyx		Tube Length (mm)	Lobe Length (mm)	Length (mm)	Width (mm)
Subgenus <i>Sphinctosiphon</i>							
<i>A. hirtella</i> var. <i>hirtella</i>							
Kearney & Peebles (1960) interpretation ¹	+	+	7-14	11-16	4-7	6-9	1.5-2.5
Correll & Johnston (1970) interpretation ²	+	+	~10	10-17	5-7	?	?
<i>A. hirtella</i> var. <i>pogonosepala</i>	-	+	8-18	10-16	3-7	6-8	1.0-2.5
<i>A. jonesii</i>	-	-	14-30	6-10	4-8	8-11	2.0-2.5
<i>A. kearneyana</i>	+	+	11-17	12-15	2-4	8-11	3.0-4.0
<i>A. palmeri</i>							
Kearney & Peebles (1960) interpretation ¹	-	- (+)	5-9	11-14	2-5	6-8	1.0-2.0
Correll & Johnston (1970) interpretation ²	+ (-)	+ (-)	4-8	8-12	3-5	6-9	1.5-2.5
<i>A. peeblesii</i>	-	-	4-9	15-19	5-12	8-11	1.5-2.5
<i>A. tharpai</i>	+	+	9-12	13-15	6-9	7-9	2.0-3.0
Subgenus <i>Longiflora</i>							
<i>A. grandiflora</i>	-	-	3-6	16-19	10-15	8-11	2.0-3.0
<i>A. longiflora</i>	-	-	1-4	23-40	7-17	5-8	1.5-2.5
<i>A. salpignanthera</i>	+	+	2-5	31-45	7-13	5-8	1.5-2.5
Subgenus <i>Articularia</i>							
<i>A. arenaria</i>	+	+	3-6	8-11	5-9	14-21	3.5-5.0
<i>A. brevifolia</i>	-	-	8-25	7-12	3-8	9-19	3.0-5.0
<i>A. eastwoodiana</i>	-	-	5-13	7-12	4-7	9-15	3.0-5.0
<i>A. tomentosa</i>	+	+	9-22	7-12	4-9	8-15	3.0-5.0
<i>A. tomentosa</i> var. <i>stenophylla</i>	+	+	3-9 (16)	9-12	4-7	11-19	3.5-6.0

Woodson (1928) believed that seeds of *A. kearneyana* were sterile. This observation, coupled with the similarity in flower morphology and geographic distributions, as known at the time, probably accounts for his later inclusion of *A. kearneyana* within *A. palmeri*. I have observed 66% germination of seeds collected from the type (and only known) locality of *A. kearneyana*. I have made other observations that may explain Woodson's belief that *A. kearneyana* does not produce viable seed. Both *A. grandiflora* Alexander and *A. kearneyana* occur in southern Arizona within the range of the stinkbug, *Chlorochroa ligata*. Following the wet winter of 1978-1979, this insect was abundant on *A. grandiflora*, attacking the seed and destroying the embryo. Seed collected in 1979 was hollow and showed 0% germination. The winter of 1979-1980 was drier and few stinkbugs were observed. *Amsonia grandiflora* seed collected in 1980 from the same population showed nearly 100% germination. It is probable that the seeds of *A. kearneyana* available to Woodson had been exposed to this insect.

Amsonia kearneyana has shorter (2-4 mm) corolla lobes and larger (3-4 mm

TABLE 2. Geographic variation within *Amsonia palmeri* (sensu lato). Measurements given are means (in mm) for all members of a sample.

Region	No. Specimens Examined	% Pubescent		Leaf Width	Corolla	
		Foliage	Calyx		Tube	Lobe
Mohave-Yavapai Cos., Arizona	20	0	50	7.5	12.5	3.5
Maricopa-Pinal-Graham Cos., Arizona	22	32	100	12.5	13.7	4.5
Cochise Co., Arizona and Hidalgo Co., New Mexico	11	64	100	9.3	13.5	4.4
Southwest Texas	14	93	93	6.0	9.9	4.5

broad) seeds than most other collections of *Amsonia* from the Southwest (Table 1). All specimens from Arizona referable to *A. hirtella* var. *hirtella* that have relatively short (~4 mm) corolla lobes also have narrower leaves, effectively differentiating them from *A. kearneyana*. The only collections that I have seen that approach *A. kearneyana* in seed size are those of Stephen White from northeastern Sonora at ARIZ (see synopsis, below), which have seeds 2.5–3.5 mm broad. Corolla lobes in these Sonoran plants are somewhat longer (4–5 mm) than those of *A. kearneyana*.

Amsonia palmeri has been separated from *A. hirtella* on the basis of corolla lobe length and ratio of length of lobe to length of tube. Woodson (1938) characterized *A. palmeri* as having corolla lobes 3–5 mm long, about one-fourth the length of the tube, and *A. hirtella* as having corolla lobes 5–7 mm long, about one-half the length of the tube. However, all specimens referable to either taxon from Arizona to west Texas overlap broadly in these corolla characters (Table 1).

No set of characters consistently separate specimens referred to *A. palmeri*, *A. hirtella* var. *hirtella*, and *A. hirtella* var. *pogonosepala*. All collections of these taxa appear to me to represent one widespread, variable species (Table 2). Pubescence is of particularly questionable diagnostic value. Plants from the northwest part of the range are glabrous except for the calyx, and populations of *A. palmeri* sensu Gray from Yavapai County, Arizona occasionally have ciliate calyx lobes. Both plants with glabrous and plants with pubescent foliage occur in the same populations throughout the central part of the range and in northeastern Sonora (Fig. 2). Pubescent plants are most common in west Texas. Leaves are narrowest at the northwest and southeast ends of the range. Corolla tubes are shortest in west Texas and the lobes are shortest in plants from northwest Arizona. The variation in these traits is more or less continuous and I find no reasonable basis for segregating varieties on the basis of these characters.

Subgenus *Sphinctosiphon*, in summary, consists of one widespread species, *A. palmeri*, and four more restricted species: *A. jonesii*, *A. kearneyana*, *A. peeblesii*, and *A. tharpaii* (Fig. 2), which have larger seeds, on average, than *A. palmeri* (Table 1). Specimens of *A. palmeri* may be either pubescent or glabrous, often within the same population, but *A. jonesii* and *A. peeblesii* are always glabrous while *A. kearneyana* and *A. tharpaii* are always pubescent.

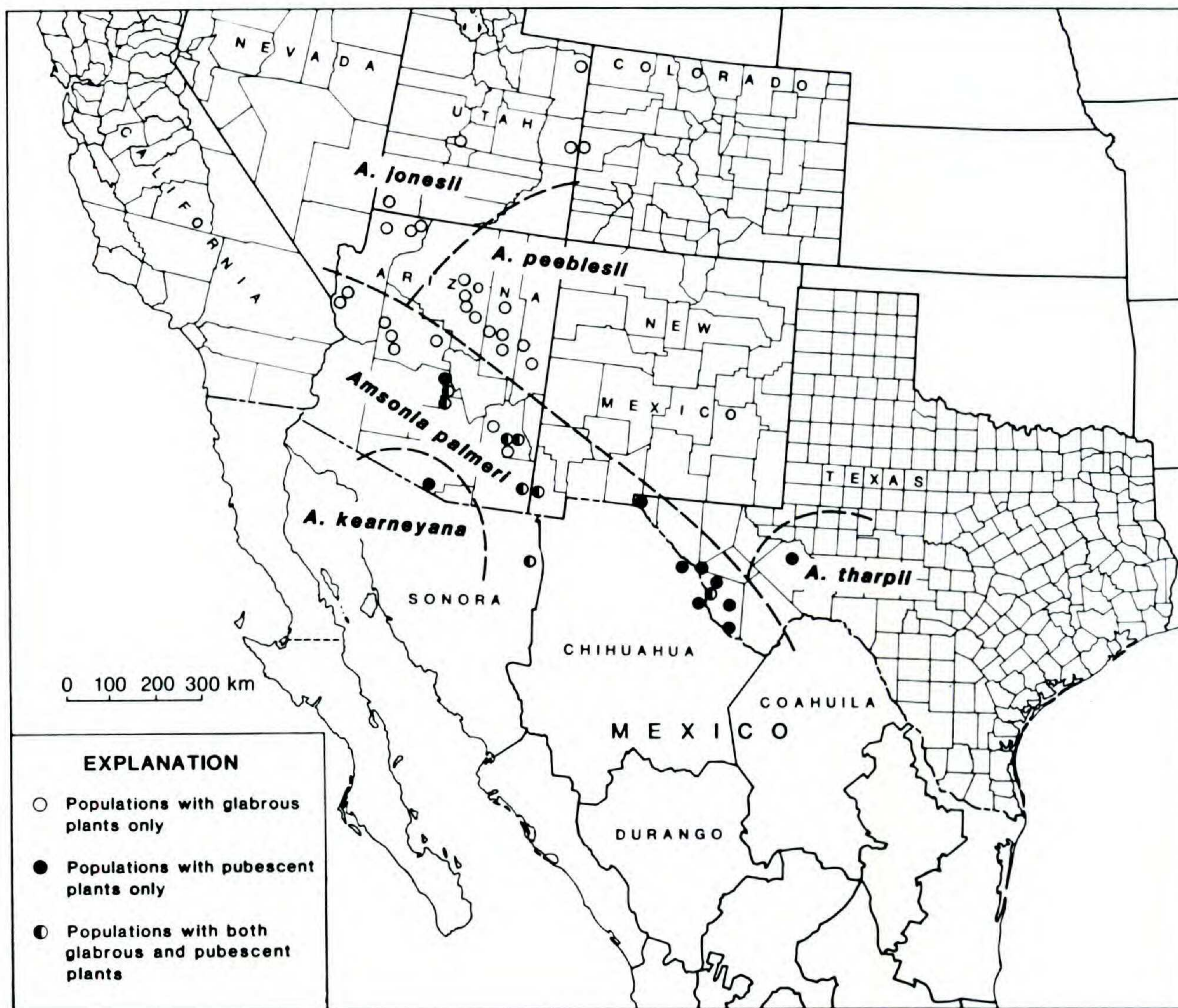


FIGURE 2. Distribution of *Amsonia* subgenus *Sphinctosiphon* taxa.

SUBGENUS *LONGIFLORA* (WOODSON) McLAUGHLIN

Woodson (1928, 1938) recognized three species in this taxon, which he treated as a section within subgenus *Sphinctosiphon*. *Amsonia grandiflora* Alexander from southern Arizona and northwestern Mexico has shorter corolla tubes, larger seeds, and broader leaves than either *A. longiflora* Torr. or *A. salpignanthea* Woodson (Table 1). Woodson separated the latter two species on the basis of pubescence, corolla lobe length, and geographic range. He characterized *A. longiflora* as glabrous with corolla lobes 11–13 mm long, occurring in extreme west Texas; and *A. salpignanthea* as pubescent with corolla lobes 5–8 mm long, occurring from the Trans-Pecos region to the eastern end of the Edwards Plateau.

Amsonia grandiflora is a reasonably distinct species, but recent collections from Texas, New Mexico, and Coahuila show a broader overlap between pubescent and glabrous plants than was previously known. Pubescent plants are now known from west Texas and New Mexico and both forms occur in Tule Canyon of the Rio Grande River between Brewster County, Texas, and Coahuila, but populations with both glabrous and pubescent plants have not been recorded (Fig.

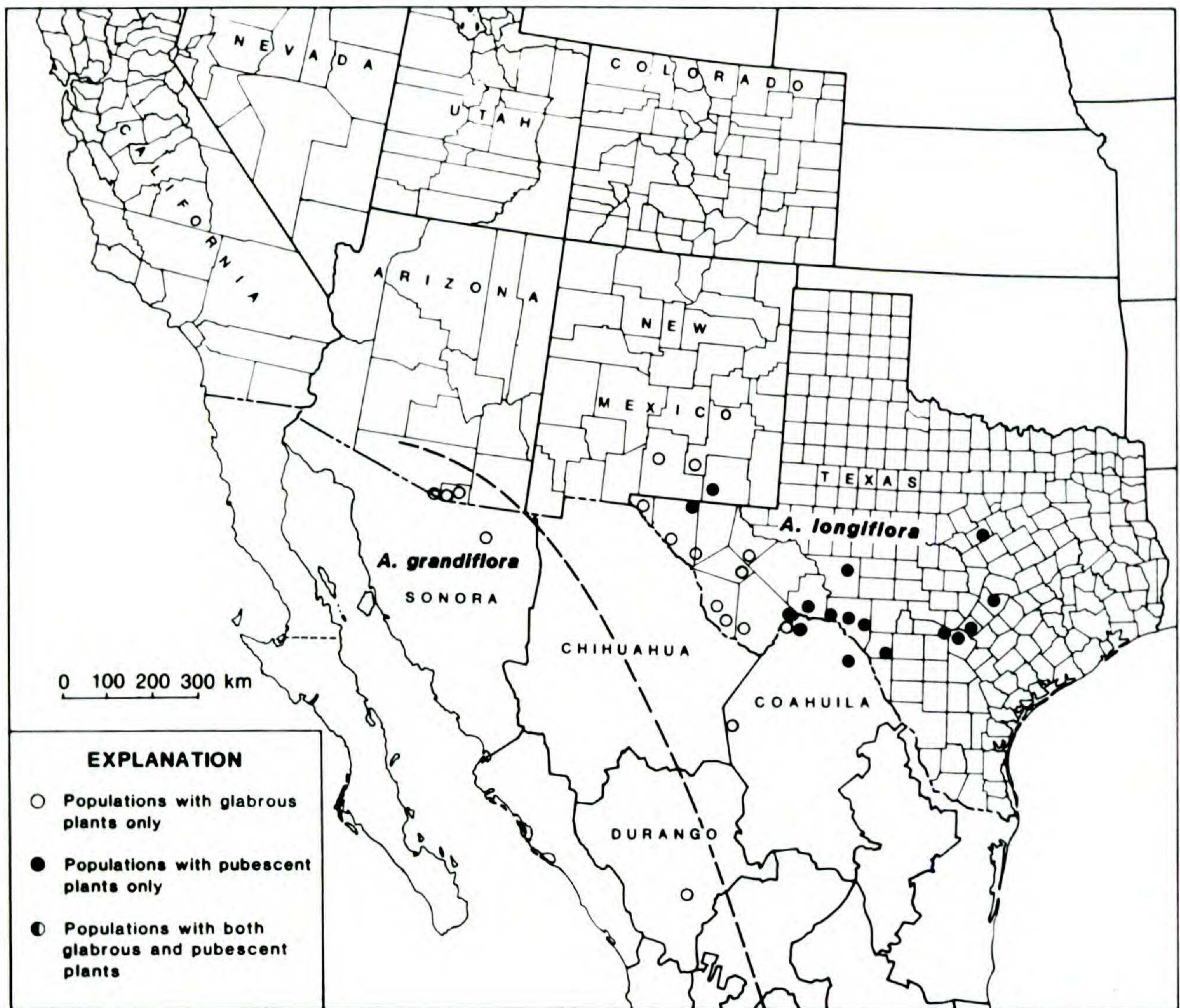


FIGURE 3. Distribution of *Amsonia* subgenus *Longiflora* taxa. Solid circles are localities for *A. longiflora* var. *salpignanthes*, open circles east of dashed line are localities for *A. longiflora* var. *longiflora*.

3). Among pubescent specimens there is considerable variation in the density and distribution of trichomes. Pubescent and glabrous plants overlap broadly in corolla lobe length, corolla tube length, leaf width, and seed size (Table 1).

Amsonia longiflora and *A. salpignanthes* do not appear to me to be sufficiently distinct to warrant recognition as two species. However, glabrous and pubescent plants do exhibit much greater geographic segregation than either the *A. palmeri* complex discussed above or the subgenus *Articularia* plants discussed below. Therefore it does seem reasonable to recognize varieties, a largely western, glabrous *A. longiflora* var. *longiflora* and a largely eastern, pubescent var. *salpignanthes*. Further exploration of the Rio Grande Valley and Trans-Pecos regions could possibly result in the discovery of populations containing both forms.

SUBGENUS *ARTICULARIA* WOODSON

The five taxa that have traditionally comprised this group are *A. brevifolia* Gray and *A. tomentosa* Torr. & Frém. from the Mohave Desert of California, Nevada, and Western Arizona; *A. eastwoodiana* Rydb. and *A. tomentosa* var.

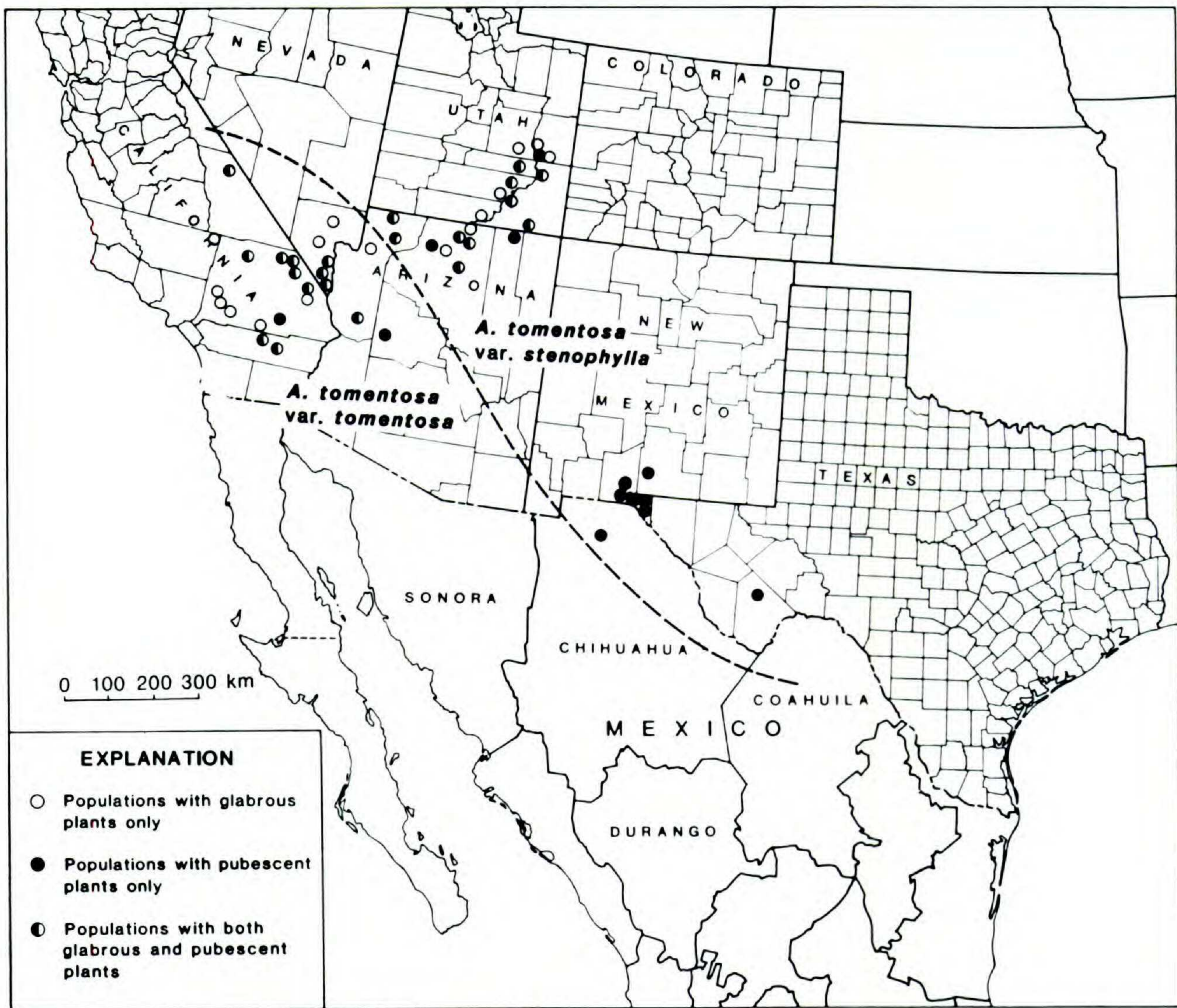


FIGURE 4. Distribution of *Amsonia* subgenus *Articularia* taxa.

stenophylla Kearney and Peebles from northern Arizona and Utah; and *A. arenaaria* Standl. from New Mexico, west Texas, and Chihuahua. Pubescence, leaf shape, corolla tube length, and seed size have been used as distinguishing characters.

Specimens from the Mohave Desert typically have broad, ovate leaves. Glabrous (*A. brevifolia*) and tomentose (*A. tomentosa*) forms are usually found growing together (Fig. 4). Woodson (1928) noted that seeds of *A. brevifolia* were noticeably smaller than those of *A. tomentosa*, but I have found seed size to be highly variable in all subgenus *Articularia* taxa (Table 1). *Amsonia eastwoodiana* and *A. tomentosa* var. *stenophylla* are narrower-leaved counterparts of the Mohave Desert plants, the former glabrous and the latter tomentulose. The two forms also occur in mixed populations in both northern Arizona and Utah.

The two glabrous species, *A. brevifolia* and *A. eastwoodiana*, have been separated on the basis of leaf shape and corolla tube length. Woodson (1928, 1938) gave corolla tube ranges of 7–10 mm for *A. brevifolia* and 9–17 mm for *A. eastwoodiana*, but I have found ranges of 7–12 mm for both (Table 1). The original description of *A. eastwoodiana* was based on two disparate elements, a plant with fruit from Utah and one with flowers from Arizona (Rydberg, 1913). The

former specimen is an *A. eastwoodiana* as known today, but the latter is clearly *A. peeblesii*. I have encountered numerous specimens of *A. peeblesii* without fruit misidentified as *A. eastwoodiana* because of the incorrect dimensions given for corolla tube length in the keys of Woodson (1928, 1938) and Kearney & Peebles (1960). The corollas of *A. eastwoodiana* and *A. peeblesii* are actually quite different in shape and size but those of *A. brevifolia* and *A. eastwoodiana* are virtually indistinguishable.

Kearney & Peebles (1939) described the pubescent, narrow-leaved plants of northern Arizona and Utah as *A. tomentosa* var. *stenophylla*. Many specimens of this variety are not distinguishable from *A. arenaria* specimens from west Texas and New Mexico. It is notable that only tomentulose plants occur in the latter areas (Fig. 4).

Leaf shape in subgenus *Articularia* does show definite geographic trends although exceptions do occur. *Amsonia brevifolia* and *A. tomentosa* have typically ovate leaves 15–25 mm broad, but a few specimens collected in San Bernardino and Riverside Counties, California, and Clark County, Nevada, have lanceolate leaves 8–11 mm broad. Likewise, *A. eastwoodiana* and *A. tomentosa* var. *stenophylla* have typically oblong-lanceolate blades 3–10 mm broad. At Cameron in Coconino County, Arizona, I found one *A. tomentosa* var. *stenophylla* plant with leaves 16 mm broad in a population with leaves otherwise consistently less than 5 mm broad. In the Grand Canyon, a natural corridor connecting the ranges of *A. brevifolia* and *A. eastwoodiana*, plants with lanceolate leaves 11–15 mm broad are common.

I grew plants from seeds of *A. brevifolia*, *A. tomentosa*, *A. eastwoodiana*, and *A. tomentosa* var. *stenophylla* in the greenhouse and in a field plot at Tucson. Survival of seedlings in the greenhouse was poor. Data from surviving plants in the field plot are presented in Table 3. Progeny of three of the parent seed sources segregated into both pubescent and glabrous forms. In collection no. 2194 of *A. brevifolia*, no pubescent plants were produced in the field but 4 of 55 greenhouse seedlings developed pubescence. Although none of the offspring of *A. tomentosa* var. *stenophylla* in the field plot were glabrous, 4 of 8 greenhouse seedlings of another lot were glabrous. Seedlings of all plants in both the greenhouse and field plot were glabrous initially—pubescence typically was not expressed until the fourth or fifth leaf was produced. None of the plants have flowered. Leaf shape in the offspring resembled that of the parent plants. Seeds from *A. eastwoodiana* and *A. tomentosa* var. *stenophylla* produced plants with significantly longer and narrower leaves than plants grown from seed of *A. brevifolia* and *A. tomentosa*.

I have found no consistent set of characters to support the traditional segregation of species in subgenus *Articularia*. From west to east across the range of the subgenus, there are several trends in morphology: toward the east pubescent plants are more common, leaves are narrower, and flowers and seeds are slightly larger. Similar trends were noted in both subgenera *Sphinctosiphon* and *Longiflora*. I interpret the entire *Articularia* complex as one variable species. Field plot observations of progeny do support the recognition of two generally distinguishable varieties, an ovate-leaved *A. tomentosa* var. *tomentosa* in the west and a lanceolate to linear-leaved var. *stenophylla* in the east.

TABLE 3. Pubescence and leaf dimensions of plants of *Amsonia* subgenus *Articularia* grown in experimental plots, Tucson, Arizona. Collection numbers are those of the author. Means within a column not followed by same letter are significantly different ($p < .05$).

Traditional Identification	Parent Plants			Offspring				
	Collection No.	Pubescence	Leaf-Shape	Total Number	Number Pubescent	Mean Leaf Length (mm)	Mean Leaf Width (mm)	L:W ratio
<i>A. brevifolia</i>	2194	No	ovate	18	0	41.3 a	15.9 a	2.7 a
<i>A. brevifolia</i>	2492	No	ovate	20	4	37.1 a	13.6 a	2.8 a
<i>A. tomentosa</i>	2491	Yes	ovate	16	11	39.8 a	14.0 a	2.9 a
<i>A. eastwoodiana</i>	2208	No	linear-lanceolate	7	2	59.4 b	7.2 b	8.3 b
<i>A. tomentosa</i> var. <i>stenophylla</i>	2507, 2509	Yes	linear-lanceolate	5	5	51.0 b	7.1 b	7.6 b

KEY TO THE SOUTHWESTERN SUBGENERA, SPECIES, AND VARIETIES OF *AMSONIA*

- 1a. Follicles markedly constricted between seeds; corolla tube short, 7–12 mm long, distinctly constricted at the apex. Subgenus *Articularia*.
- 2a. Leaves ovate, (8–)10–25 mm broad; plants of California, Nevada, and western Arizona. 8a. *A. tomentosa* var. *tomentosa*
- 2b. Leaves oblong-lanceolate to linear-lanceolate, 3–13(–16) mm broad; plants of northern Arizona, Utah, New Mexico, Texas, and Chihuahua. 8b. *A. tomentosa* var. *stenophylla*
- 1b. Follicles not markedly constricted between seeds; corolla tube either longer, 16–45 mm, or not distinctly constricted at the apex.
- 3a. Corolla tube long, 16–45 mm, distinctly constricted at apex; leaves narrow, 1–6 mm broad. Subgenus *Longiflora*.
- 4a. Corolla tube 16–19 mm long; foliage glabrous; plants of Santa Cruz Co., Arizona, Sonora, and Durango. 7. *A. grandiflora*
- 4b. Corolla tube 23–45 mm long; plants with either glabrous or pubescent foliage.
- 5a. Foliage glabrous; plants of southern New Mexico, west Texas, Coahuila, and Chihuahua. 6a. *A. longiflora* var. *longiflora*
- 5b. Foliage pubescent; plants of Southern New Mexico, west Texas to east end of Edwards Plateau, and Coahuila. 6b. *A. longiflora* var. *salpignanthera*
- 3b. Corolla tube shorter, 6–19 mm long, not distinctly constricted at apex; leaves 4–30 mm broad. Subgenus *Sphinctosiphon*.
- 6a. Seeds broad, typically 3–4 mm in width; foliage pubescent; corolla lobes 2–4 mm long; plants of Baboquivari Mts., Pima Co., Arizona. 3. *A. kearneyana*
- 6b. Seeds narrower, usually less than 2.5 mm broad; foliage either glabrous or pubescent; corolla lobes (2–)4–12 mm long.
- 7a. Leaves ovate, 14–30 mm broad; foliage glabrous; plants of northwestern Arizona, Utah, and western Colorado. 2. *A. jonesii*
- 7b. Leaves linear to elliptic-lanceolate, 3–15 mm broad; foliage glabrous or pubescent.
- 8a. Plants low growing, generally less than 20 cm tall; leaves noticeably dimorphic, lower leaves elliptic-lanceolate, upper leaves linear; foliage hirtellous; plants of Pecos Co., Texas. 5. *A. tharpii*
- 8b. Plants taller, generally more than 30 cm tall; leaves not noticeably dimorphic, instead gradually narrower distally; foliage glabrous or hirtellous.
- 9a. Stem much branched below inflorescence, the latter barely surpassing the foliage; corolla tube 15–19 mm long, lobes 5–12 mm long; foliage glabrous; plants of northwestern Arizona. 4. *A. peeblesii*

- 9b. Stem sparingly branched below inflorescence, the latter well surpassing the foliage; corolla tube 10–15 mm long, lobes 2–7 mm long; foliage glabrous or hirtellous, often within the same population; plants widespread from Mohave Co., Arizona, southeast to Presidio Co., Texas. ----- 1. *A. palmeri*

Amsonia subgenus **Sphinctosiphon** (K. Schumann) Woodson, Ann. Mo. Bot. Gard. 15:411. 1928. TYPE: *A. palmeri* Gray.

1. **Amsonia palmeri** Gray, Proc. Am. Acad. 12:64. 1877. TYPE: United States, New Mexico, without additional locality information, 1851–1852, *Wright 1669* (GH, neoholotype; MO!, neoisotype). Described from plants grown from seed, type assigned by Woodson (1928).

- A. fremonti* Rydb., Bull. Torrey Bot. Club 40:465. 1913. Nomen nudum.
A. hirtella Standl., Proc. Biol. Soc. Wash. 26:118. 1913. TYPE: United States, New Mexico, Grant Co., *Mearns 117* (US, holotype).
A. pogonosepala Woodson, Ann. Mo. Bot. Gard. 15:412. 1928. *A. hirtella* var. *pogonsepala* (Woodson) Wiggins, Contr. Dudley Herb. 4:21. 1950. TYPE: United States, Arizona, San Francisco Mts., *Rusby 256* (MO!, holotype; NY, PH, isotypes).
A. standleyi Woodson, Ann. Mo. Bot. Gard. 15:412. 1928. TYPE: United States, New Mexico, without additional locality information, 1851–1852, *Wright s.n.* (GH, holotype).
A. arizonica Nels., Am. J. Bot. 18:432. 1931. TYPE: United States, Arizona, Yavapai Co., 20 mi. S of Ashfork, *Nelson 10247*, (RM, holotype).
A. bififormis Nels., Am. J. Bot. 32:288. 1945. TYPE: United States, Arizona, Graham Co., W of Duncan, *Nelson 11278–9* (RM, holotype).

Herbaceous perennial, glabrous or pubescent, 30–80 cm tall; lower leaves lanceolate to linear, 4–18 mm broad; upper leaves linear-lanceolate; calyx lobes subulate, glabrous, ciliate along margins, or densely pubescent, 2–7 mm long; corolla tube 8–17 mm long, broadest below the apex, moderately constricted at the orifice, lobes 2–7 mm long; follicles 2–13 cm long; seeds cylindrical, corky, 6–10 mm long, 1.0–2.5 mm broad. Mohave County, Arizona, southeastward below the Mogollon Rim in Arizona to southwest Texas, northeastern Sonora, and northern Chihuahua.

This is a variable species that is not readily separable into varieties. Pubescence cannot be used as a diagnostic character since glabrous and densely pubescent forms occur in mixed populations throughout much of the range. On an annotation to a herbarium specimen (*Peebles 11655*, ARIZ!), Woodson noted that plants grown from seed of a single follicle segregated into glabrous and pubescent forms. The materials Woodson (1928) designated as the type specimens for *A. palmeri* (*Wright 1669*) and *A. standleyi* (*Wright s.n.*), which differ primarily in pubescence, bear similar notations and probably were collected from the same population.

Pubescent specimens from the Rio de Bavispe region of northeastern Sonora (*McLaughlin & Bowers 2556*, ARIZ) are very similar to *A. kearneyana* in vegetative morphology. However, corolla lobe length (4–5 mm) in both glabrous and pubescent plants from this area exceeds that of typical *A. kearneyana* (2–4 mm long). The only fruiting specimens from this area (*White 505, 3021*, ARIZ!) have seeds 2.5–3.5 mm long, wider than typical *A. palmeri* but narrower than typical *A. kearneyana*. The presence of both glabrous and pubescent plants in the same

same population and the relatively long corolla lobes suggest to me a much closer affinity of these plants to *A. palmeri* than to *A. kearneyana*. Additional material from northeastern Sonora would be valuable.

2. ***Amsonia jonesii*** Woodson, Ann. Mo. Bot. Gard. 15:414. 1928. *A. latifolia* Jones, Cont. West. Bot. 12:50. 1908. Not *A. latifolia* Michx., Fl. Bor. Am. 1: 121. 1803. TYPE: United States, Utah, Sevier Co., Monroe, *M. E. Jones 6446* (RSA, holotype, MO!, isotype). RSA 75995 (*Jones*, 6 June 1913), which is labeled as a type for *A. jonesii*, is a specimen of *A. tomentosa* var. *stenophylla*.

Herbaceous perennial, glabrous, 15–50 cm tall; lower leaves ovate, 14–30 mm broad; upper leaves lanceolate, 3–10 mm broad; calyx lobes ovate to lanceolate, 1–4 mm long; corolla tube 6–10 mm long, broadest below the apex, slightly constricted at the orifice, lobes 4–8 mm long; follicles 1.5–9 cm long; seeds cylindrical, corky, 6–8 mm long, 2.0–2.5 mm broad. Northwestern Arizona, Utah, and western Colorado.

Specimens lacking fruit can be mistaken for glabrous forms of *A. tomentosa* var. *tomentosa*. The latter species occurs within or south of the Grand Canyon in Arizona, and its corolla tube is broadest at the apex and markedly constricted at the orifice. Corolla lobes of *A. tomentosa* are typically about $\frac{1}{2}$ – $\frac{2}{3}$ the length of the tube while those of *A. jonesii* are nearly as long as the tube.

3. ***Amsonia kearneyana*** Woodson, Ann. Mo. Bot. Gard. 15:415. 1928. TYPE: United States, Arizona, Pima Co., Baboquivari Mts., *Thackery 55* (MO!, holotype).

Herbaceous perennial, pubescent, 40–90 cm tall; lower leaves lanceolate, 11–17 mm broad, upper leaves linear-lanceolate, 3–8 mm broad; calyx lobes subulate, 3–6 mm long; corolla tube 12–15 mm long; broadest below the apex, slightly constricted at the orifice, lobes 2–4 mm long; follicles 3–10 cm long; seeds cylindrical, corky, 8–11 mm long, 3–4 mm broad. Baboquivari Mountains, Pima County, Arizona.

4. ***Amsonia peeblesii*** Woodson, Bull. Torrey Bot. Club 63:35. 1936. TYPE: United States, Arizona, Coconino Co., near Leupp, *Kearney and Peebles 9568* (MO!, holotype).

Herbaceous perennial, glabrous, 40–90 cm tall; lower leaves oblong-linear, 4–9 mm wide, upper leaves linear, 1–2 mm wide; calyx lobes ovate to linear, 2–7 mm long; corolla tube 13–19 mm long, broadest below the apex, slightly constricted at the orifice, lobes 5–10 mm long; follicles 2–10 cm long; seeds cylindrical, corky, 8–11 mm long, 1.5–2.5 mm broad. Coconino, Navajo, and Apache Counties, Arizona.

Flowering specimens of this species have often been misidentified as the glabrous form of *A. tomentosa* var. *stenophylla* (*A. eastwoodiana*). The corolla tube of the latter is shorter (7–12 mm) and markedly constricted at the apex.

5. **Amsonia tharpia** Woodson, Ann. Mo. Bot. Gard. 35:237. 1948. TYPE: United States, Texas, Pecos Co., 21 mi. NE of Ft. Stockton, *Warnock 46183* (MO!, holotype; TEX!, isotype).

Herbaceous perennial, pubescent, 10–20 cm tall; leaves distinctly dimorphic, lower leaves elliptic-lanceolate, 9–12 mm broad, upper leaves linear-lanceolate, 1–4 mm broad; calyx lobes narrowly lanceolate to subulate, 2–6 mm long; corolla tube 13–16 mm long, broadest below the apex, slightly constricted at the orifice, lobes 6–9 mm long; follicles 2–12 cm long; seeds cylindrical, corky, 7–9 mm long, 2–3 mm broad. Pecos County, Texas.

Amsonia subgenus **Longiflora** (Woodson) McLaughlin comb. nov. TYPE: *A. longiflora* Torr.

Woodson (1928) treated this taxon as a section of subgenus *Sphinctosiphon* because the follicles are continuous in both. The flowers of subgenus *Longiflora* species, however, are distinctly different from those in subgenus *Sphinctosiphon*. In subgenus *Longiflora*, the corolla lobes are long (usually >10 mm) and spreading and the corolla tubes are long (>15 mm), slender, with a distinct constriction at the apex, but in subgenus *Sphinctosiphon* the lobes are shorter (usually <10 mm), erect to spreading, and the tubes are shorter (usually <15 mm, except in *A. peeblesii*) and only moderately constricted at the apex. The anthers in subgenus *Longiflora* are positioned at the top of the corolla tube just below the constriction, but in subgenus *Sphinctosiphon* (except occasionally in *A. jonesii*, which has a very short corolla tube) the anthers are positioned lower in the tube, from about midway in *A. palmeri* and *A. peeblesii* to the upper ¼ in *A. tharpia*. In addition, the broadest leaves in subgenus *Longiflora* are very narrow (>10 times as long as broad) while those in subgenus *Sphinctosiphon* are broader (typically 2–8 times as long as broad). Subgenus *Longiflora* populations also occur in more mesic habitats than either subgenus *Sphinctosiphon* or *Articularia* populations. These differences, I believe, justify elevating *Longiflora* to subgeneric rank.

6. **Amsonia longiflora** Torr., Bot. Mex. Bound. Surv. 159. 1859. TYPE: United States, Texas, El Paso Co., near El Paso, *Wright 1168* (NY, holotype; GH, MO!, isotypes).

Herbaceous perennial, glabrous or pubescent, 20–60 cm tall; lower leaves linear-lanceolate, 1–5 mm broad, upper leaves filiform, 1 mm broad; calyx lobes linear, 2–9 mm long; corolla tube 23–45 mm long, broadest at the apex, markedly constricted at the orifice, lobes 7–17 mm long; follicles terete, 4–20 cm long; seeds cylindrical, corky, 5–8 mm long, 1.5–2.5 mm broad.

6a. **Amsonia longiflora** Torr. var. **longiflora**.

Plants glabrous, corolla tubes generally 25–40 mm long. Southern New Mexico, west Texas, and Coahuila.

- 6b. **Amsonia longiflora** var. **salpignatha** (Woodson) McLaughlin, comb. nov. *Amsonia salpignantha* Woodson, Ann. Mo. Bot. Gard. 15:417. 1928. TYPE:

United States, Texas, Hamilton Co., *Reverchon 1557* (F, holotype; MO! isotype).

Plants hirtellous, corolla tubes generally 35–45 mm long. Southern New Mexico, west Texas east to the Edwards Plateau, and northern Coahuila.

7. ***Amsonia grandiflora*** Alexander, *Torreyana* 34:116. 1934. TYPE: United States, Arizona, Santa Cruz Co., near Patagonia, *Peebles, Harrison & Loomis 6986*, (US, holotype; ARIZ!, isotype).

Herbaceous perennial, glabrous, 40–90 cm tall; lower leaves linear-lanceolate, 3–6 mm broad; upper leaves linear, 1–3 mm broad; calyx lobes linear, 3–7 mm long; corolla tube 16–20 mm long, broadest at the apex, markedly constricted at the orifice, lobes 10–15 mm long; follicles terete, 4–15 cm long; seeds cylindrical, corky, 8–11 mm long, 2–3 mm broad. Santa Cruz County, Arizona, adjacent northeastern Sonora, and a single collection (*Palmer 90*, MO!) from Durango.

Amsonia subgenus ***Articularia*** Woodson, *Ann. Mo. Bot. Gard.* 15:418. TYPE: *A. tomentosa* Torr. & Frém.

8. ***Amsonia tomentosa*** Torr. & Frém., Torr. in Frém. Rep. Calif. 316. 1845. TYPE: United States, without locality information, *Fremont*, 2nd exped. (NY!, holotype).

Herbaceous perennial, glabrous or tomentose, 20–60 cm tall; lower leaves ovate to linear, 3–25 mm broad, upper leaves lanceolate to filiform, 1–10 mm broad; calyx lobes linear, 2–9 mm long; corolla tube 7–12 mm long, broadest at the apex, markedly constricted at the orifice, lobes 3–9 mm long; follicles articulate-moniliform, 2–8 cm long; seed elliptic, corky, 8–21 mm long, 3–6 mm broad.

8a. *Amsonia tomentosa* var. *tomentosa*.

A. brevifolia Gray, *Proc. Am. Acad.* 12:64. 1877. *A. brevifolia* var. *tomentosa* Jepson, *Man. Fl. Pl. Calif.* 768. 1925. TYPE: United States, Arizona, Mohave Co., Mokiah Pass, *Palmer 302* (GH, holotype).

A. lanata Alexander, *Torreyana* 34:117. 1934. TYPE: United States, Nevada, Clark Co., Cottonwood Spring, *Bailey et al. 1884* (US, holotype).

Glabrous or tomentose plants; lower leaves ovate to ovate-lanceolate. Southern California, southern Nevada, and northeastern Arizona.

- 8b. *Amsonia tomentosa* var. *stenophylla*** Kearney and Peebles, *J. Wash. Acad. Sci.* 29:487. 1939. TYPE: United States, Arizona, Navajo Co., Monument Valley, *Peebles and Fulton 11944* (US, holotype).

A. arenaria Standl., *Proc. Biol. Soc. Wash.* 26:117. 1913. TYPE: United States, Texas, El Paso Co., sand hills between Strauss and Anapra, *Stearns 372* (US, holotype).

A. eastwoodiana Rydb., *Bull. Torrey Bot. Club* 40:465. 1913. Nomen ambiguum.

A. filiformis Nels., *Am. J. Bot.* 18:433. 1931. TYPE: Mexico, Chihuahua, near Lake Guzman, *Pringle 6796* (RM, holotype; GH, MO, RSA, isotypes).

Glabrous or tomentose plants; lower leaves lanceolate to linear-lanceolate. Utah, northern Arizona, southern New Mexico, west Texas and northern Chihuahua.

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